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## Estimation of Base Employment Multipliers for Nonmetropolitan Tennessee Counties

University of Tennessee Agricultural Experiment Station

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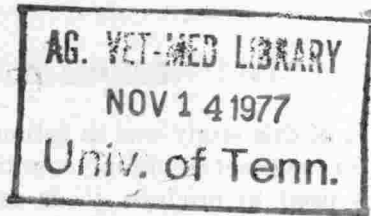
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June 1977



**Estimation  
of  
Base Employment Multipliers  
for  
Nonmetropolitan Tennessee Counties**

by Thomas H. Klindt

THE UNIVERSITY OF TENNESSEE  
AGRICULTURAL EXPERIMENT STATION  
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## SUMMARY

The objective of this study was to estimate base employment multipliers for nonmetropolitan counties in Tennessee. When employment is used to produce goods and services which are exported from a county, it is expected that the resulting flow of funds into the county would generate secondary economic activity because of interindustry transactions. These secondary effects would, in turn, be associated with additional employment in the county. Base or export employment multipliers indicate the amount by which total employment would be affected by a one-employee change in export activity by a given sector in a county.

To estimate base employment multipliers in this study, cross-sectional secondary data for 1970 were used. Estimates of base (export) employment were made for each county by broad SIC groups. By using ordinary least squares techniques, base employment was used to explain total county employment and obtain base employment multipliers.

Estimates for individual industries were: agriculture, 2.17; manufacturing, 1.89; mining, 3.46; construction, 3.89; transportation and communications, 4.72; wholesale and retail trade, 1.54; finance, insurance, and real estate, 1.36; and services, 2.77.

It was recognized that estimates were for a cross-section of non-metropolitan counties in Tennessee. Multipliers for individual counties may differ substantially from those reported due to differences in the size of the county economy, degree of isolation, and differences in trading patterns among industries in a county. Therefore, while the estimated multipliers are believed to be of value in generalized planning, they are not intended to replace more accurate case studies for individual county planning purposes.

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# Estimation of Base Employment Multipliers For Nonmetropolitan Tennessee Counties

Thomas H. Klindt\*

## INTRODUCTION

Economic planning in rural Tennessee counties often hinges on an ability to predict the total change in economic activity which would result from modifying the economic activity of a specific industry. However, quantifying this relationship in terms of multipliers has been difficult for county-sized economic areas.

The most precise method of determining the magnitude of inter-industry relationships for a geographic area is input-output analysis. However, the costs inherent in primary data requirements effectively prohibit the use of input-output analysis for each rural county. Thus, a means of estimating the results of economic interaction from secondary data is needed.

The theoretical constructs used in this study stemmed from the concept of an economic base. The premise of economic base studies have been well developed in the literature (e.g., Tiebout [5]). In essence, it is argued that economic activity in an area economy may be segregated into two components—base and secondary. Briefly, the output of base economic activity is exported from the area economy under study while secondary output is utilized by businesses and consumers within the area. In this dichotomy the existence and level of secondary output depends upon base output. Returns from the export of base output infuse moneys in an area economy. The secondary economic activity is generated due to internal interindustry trade. Secondary effects from a given export sale diminish over time because of leakages from the economy due to imports. However, in the process, employment and income have been used to quantify the relationship between base and secondary

Several measures such as output, income, or employment have been used to quantify the relationship between base and secondary economic activity. The unit of measure used in this study was employment because data were readily available, results would be more comparable with other economic base studies which have traditionally used employment data, and because employment was considered to be a relatively accurate indicator of economic activity.

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## OBJECTIVE

The objective of this study was to develop a technique for estimating base employment multipliers for rural Tennessee counties. More specifically, the purpose was to estimate multipliers for broad industrial classifications utilizing 1970 data.

## DATA

Secondary employment, population, and income data were obtained for 72 nonmetropolitan counties in Tennessee.<sup>1</sup> Data used were from the 1970 Census of Population as compiled and reported in the *Tennessee Statistical Abstract* [4] and the 1972 *County and City Data Book* [6].

## PROCEDURE

The relationship between base and secondary employment was quantified in base employment multipliers. This multiplier for a given industry represents the total amount of employment created in an area (county in this study) as a result of an additional employee in the industry in question producing goods and/or services for export from the county. In this study, multipliers were estimated using ordinary least squares (OLS) techniques. The model used was as follows:

$$TE_i = b_0 + b_1X_{i1} + b_2X_{i2} + \dots + b_jX_{ij} + e \quad (1)$$

where

$TE_i$  = total employment in county  $i$

$X_{ij}$  = base employment in the  $j^{\text{th}}$  industry in county  $i$

$b_0$  = a constant

$b_1 \dots b_j$  = base employment multipliers for  $j$  industries

$e$  = random error

To use the model specified in equation 1, it was first necessary to estimate levels of base employment for each industry during 1970. Employment in three industries—agriculture, manufacturing, and mining—was assumed to be completely base oriented. That is, all output of the three industries was assumed to be exported from

<sup>1</sup> This includes all nonmetropolitan (as defined in April, 1973) counties except Madison, Montgomery, and Washington counties which were excluded to remove the effects of Fort Campbell, a large military reservation, and Jackson and Johnson City, two sizable trade centers which were believed to be more characteristic of SMSA's than rural counties.

the rural county in which it was produced. However, it was recognized that employment in other industries, hereafter referred to as mixed industries, could be partly base and partly secondary. These industries included construction, transportation and utilities, wholesale and retail trade, FIRE (finance, insurance, and real estate), and services.<sup>2</sup> Employment in a retail trade establishment, for example, could serve consumers both inside and outside the county in which it was located. For purposes of analysis, it was necessary that the portion of employment used in export trade be counted as base employment. However, data to differentiate base and secondary employment within specific industries was unavailable and a method of estimation was necessary.

A county's employment in a mixed industry may be conceptualized as being equal to employment required to satisfy local consumption plus exports minus imports. Alternatively, export (base) employment for the mixed industry is total employment in the industry minus the employment required to satisfy local demands plus the employment equivalent of imports. These identities were used to estimate base employment for each mixed industry in a county. The procedure required two stages. First, coefficients for the following model were estimated using OLS techniques with 1970 data:

$$E_{ij} = b_0 + b_1P_i + b_2P_i^2 + b_3Y_i + b_4L_i + b_5S_i + b_6R_i + e \quad (2)$$

$E_{ij}$  = employment in the  $j^{\text{th}}$  industry in county  $i$ , 1970  
[4, Table 12.5]

$P_i$  = population in county  $i$  [4, Table 16.6]

$P_i^2$  = population squared in county  $i$

$P_i^2$

$Y_i$  = per capita income in county  $i$  [4, Table 11.8]

$L_i$  = population in county  $i$ , if county  $i$  was adjacent to a county with a larger population center, or 0 if county  $i$  was not adjacent to a county with a larger population center<sup>3</sup>

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<sup>2</sup> After an examination of the data, public administration was assumed to be wholly secondary.

<sup>3</sup> For these purposes, population centers were grouped into seven categories of size: less than 2,500, 2,500 to 4,999, 5,000 to 9,999, 10,000 to 24,999, 25,000 to 49,999, 50,000 to 249,999, and 250,000 or more. Data for population centers were from [6, Table 2B].

- $S_i$  = population of counties which were adjacent to and had a smaller population center than county  $i$ , or 0 if county  $i$  was not adjacent to counties with a smaller population center <sup>4</sup>
- $R_i$  = 1 if county  $i$  was adjacent to or included a national park, state park, TVA lake, or Corps of Engineers lake or 0 if county  $i$  was not adjacent to one of the above
- $b_0$  = a constant term
- $b_1 \dots b_8$  = coefficients to be estimated
- $i$  = 1, ..., 72
- $j$  = 4, ..., 8 (recall that three industries were assumed to be wholly base and were not included in this portion of the analysis)
- $e$  = error term

The purpose of the model specified in equation 2 was to estimate an expected level of employment in each mixed industry which was needed for indigenous consumption and the level which was imported and exported. Population, population squared, and per capita income were hypothesized as variables which would explain the amount of a mixed industry's employment needed for consumption within a county. The population squared term was used to account for nonlinearity in the relationship between population and employment required in an industry to serve the population.

Adjacency to a county with a larger population center was used as a proxy to estimate import levels. It was expected that adjacency to a larger population center would draw consumer and business expenditures out of the county in question. Therefore, the sign on the estimated coefficient was expected to be negative.

Adjacency to counties in which the population center was smaller was entered as a proxy to reflect exports. It was expected that consumers and businesses in smaller adjacent counties would make purchases in the county in question. Therefore, the sign on the estimated coefficient was expected to be positive. Similarly, the existence of a park or lake in or adjacent to a county was expected to be related to export sales. The sign on the estimated coefficient was expected to be positive.

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<sup>4</sup> *Ibid.*



After coefficients in equation 2 were estimated for each mixed industry, base or export employment for each was estimated by specifying the following equation:

$$X_{ij} = E_{ij} - [b_0 + b_1P_i + b_2P_i^2 + b_3Y_i] - b_4L_j \quad (3)$$

where  $X_{ij}$  was constrained to be nonnegative.

Each of the variables in equation 3 were specified in conjunction with equations 1 and 2. Equation 3 specified base employment in a mixed industry  $j$  in county  $i$  ( $X_{ij}$ ) as being equal to observed employment in that industry and county ( $E_{ij}$ ), minus the estimated employment needed to serve consumption in that county, plus estimated imports into the county. (Adding imports is consistent with equation 3 since  $b_4$  was hypothesized to have a negative sign.) Equation 3 is simply a reordering of equation 2, with  $X_{ij}$  (base employment) taking the place of two export variables and the error term of equation 2. The validity of entering the error term in base employment rests on the assumption that the "required" secondary employment was correctly specified and measured and that error related to incomplete specification and measurement of the import and export proxy variables. When the error term was positive, the unexplained variation was attributed to exports. When the error term was negative, reductions were made in estimated export employment until the zero level was reached. Thereafter, additional necessary modifications were implicitly assigned to importation.

After base employment was estimated by use of equation 3, results were used in the model specified in equation 1 to estimate base employment multipliers for each industry.

## RESULTS

The preceding methodology was used in conjunction with data from 72 rural Tennessee counties to obtain estimates of base employment multipliers for eight industries. The first stage in the procedure was estimation of base employment in mixed industries for each county.

### Estimation of Base Employment

Equations used in estimating base employment for five mixed industries in each county are shown in Table 1.<sup>5</sup> The first row shows the equation used to estimate base employment for the construction industry in each county. Base employment was estimated to be

<sup>5</sup> Recall that base employment for the remaining three industries was assumed to be equal to total employment in each industry.

Table 1. Equations used to estimate base employment in non-SMSA county mixed industries for 1970 <sup>a</sup>

Industry	Base employment <sup>b</sup>	=	Observed employment	— [ "Required" secondary employment ] + Imports
Construction	X <sub>14</sub>	=	E <sub>14</sub>	— [ -30 + .02313P <sub>1</sub> + .00000006P <sub>1</sub> <sup>2</sup> + .03241Y <sub>1</sub> ] — [ -.00057L <sub>1</sub> ]
Transportation and utilities	X <sub>15</sub>	=	E <sub>15</sub>	— [ -212 + .01464P <sub>1</sub> + .00000001P <sub>1</sub> <sup>2</sup> + .11634Y <sub>1</sub> ] — [ -.00180L <sub>1</sub> ]
Wholesale and retail trade	X <sub>16</sub>	=	E <sub>16</sub>	— [ -621 + .07075P <sub>1</sub> + .00000001P <sub>1</sub> <sup>2</sup> + .19741Y <sub>1</sub> ] — [ -.01187L <sub>1</sub> ]
Finance, insurance, and real estate	X <sub>17</sub>	=	E <sub>17</sub>	— [ -109 + .00569P <sub>1</sub> + .00000010P <sub>1</sub> <sup>2</sup> + .05001Y <sub>1</sub> ] — [ -.00154L <sub>1</sub> ]
Services	X <sub>18</sub>	=	E <sub>18</sub>	— [ -504 + .08466P <sub>1</sub> + .00000002P <sub>1</sub> <sup>2</sup> + .13763Y <sub>1</sub> ] — [ -.00995L <sub>1</sub> ]

<sup>a</sup> The form of each equation is the same as specified in equation 3 in the previous section. The coefficients shown in each equation of this table were estimated by use of the model

specified in equation 2 in the previous section. Coefficients estimated for equation 2, together with model statistics, are presented in Appendix Table 1.

<sup>b</sup> Base employment is constrained to be nonnegative.

equal to observed employment minus the amount of construction employment needed to serve the county in question plus the amount of employment imported due to the county in question plus the amount of employment imported due to the county in question being adjacent to a county with a larger population center. For example, 1970 construction employment in Overton County was 436. It was estimated that 387 construction employees were needed in the county and that the equivalent of nine additional employees was imported into the county. Therefore, it was estimated that the equivalent of 58 units of employment was exported during the year.

For each of the five mixed industries listed in Table 1, the estimated level of employment needed within a county in 1970 was positively associated with population and income and was positively associated with population squared in four of the five industries. Moreover, in each instance adjacency to a county with a larger population center had the hypothesized effect.

#### Estimation of Base Employment Multipliers

Base employment multipliers were estimated by utilizing the model specified in equation 1 and reiterated below:

$$TE_i = b_0 + b_1X_{i1} + b_2X_{i2} + \dots + b_8X_{i8} + e \quad (4)$$

where

$TE_i$	= total employment in county i
$X_{i1}$	= base employment in the agricultural industry of county i
$X_{i2}$	= base employment in the manufacturing industry of county i
$X_{i3}$	= base employment in the mining industry of county i
$X_{i4}$	= base employment in the construction industry of county i
$X_{i5}$	= base employment in the transportation and utilities industry of county i
$X_{i6}$	= base employment in the wholesale and retail trade industry of county i
$X_{i7}$	= base employment in the FIRE (finance, insurance and real estate) industry of county i
$X_{i8}$	= base employment in the service industry of county i
$b_0$	= a constant
$b_1 \dots b_8$	= base employment multipliers
$i$	= 1, ..., 72
$e$	= an error term

Levels of base employment for the agricultural, manufacturing, and mining industries ( $X_{11}$ ,  $X_{12}$ , and  $X_{13}$ ) were specified as the observed level of employment in these industries in 1970, as it was assumed that these industries were completely basic. Levels of base employment for the remaining five mixed industries ( $X_{14}$  . . .  $X_{18}$ ) were estimated by use of equations shown in Table 1.

Estimated coefficients from equation 4 are shown in Table 2.

The estimated base employment multiplier for the agricultural industry was 2.17. This means that an additional employee in the agricultural industry in a rural county would result in a 2.17 increase in total county employment, or 1.17 employees throughout all industries in addition to the one agricultural employee. Other multipliers may be interpreted accordingly.

Table 2. Estimated base employment multipliers for rural Tennessee counties, 1970 <sup>a</sup>

Industry	Base employment multiplier
Agriculture ( $b_1$ )	2.17** ( .25) <sup>b</sup>
Manufacturing ( $b_2$ )	1.89** ( .05)
Mining ( $b_3$ )	3.46** ( .71)
Construction ( $b_4$ )	3.89** (1.13)
Transportation and communications ( $b_5$ )	4.72** (1.09)
Wholesale and retail trade ( $b_6$ )	1.54* ( .81)
FIRE ( $b_7$ )	1.36 (3.34)
Services ( $b_8$ )	2.77** ( .28)

\*Indicates significance at the .1 level.

\*\*Indicates significance at the .01 level.

<sup>a</sup> The  $b_0$  coefficient for equation 4 was -819,  $R^2 = .98$ ,  $F = 399$ , degrees of freedom = 63.

<sup>b</sup> Standard error.

Relatively small multipliers for FIRE (1.36), wholesale and retail trade (1.54), and manufacturing (1.89) imply that employment in these industries stimulates less intracounty economic interaction than other industries. Estimated multipliers for other industries were larger: services (2.77), mining (3.46), construction (3.89), and transportation and communication (4.72). The results imply that employment in these industries were associated with relatively greater levels of intracounty economic interdependence.

The estimated coefficients for all but two of the industries were highly significant. The wholesale and retail trade coefficient was significant at the 0.1 level while the coefficient for the FIRE industry was not significant at traditionally used levels. This implies that estimated multipliers for these two industries were not as reliable as desired. Therefore, caution should be exercised in interpreting and using these estimates.

#### COMPARISON OF RESULTS WITH OTHER ESTIMATES OF COUNTY EMPLOYMENT MULTIPLIERS

Since employment multipliers are abstractions, there is no benchmark against which estimates may be compared and validated. For that reason, estimated multipliers from this study were compared with results from other similar studies in which employment multipliers were estimated. Results from three such studies are presented in Table 3. In the first column, results of the current study are reiterated. Results from a study by Braschler and Kuehn [1] are shown in columns 2 and 3. Briefly, Braschler and Kuehn used methods comparable to those used in this study to estimate 1970 employment multipliers for nonmetropolitan Ozark counties. Base employment was estimated for each industry and employment multipliers were estimated by OLS techniques. The primary difference between the Braschler and Kuehn and the current study stemmed from differences in methods used to estimate base employment. Braschler and Kuehn reported results, using the same methodology with two groups of counties. The first, termed Braschler and Kuehn "1," was for Ozark counties with less than 20,000 population. The second, termed Braschler and Kuehn "2," was for nonmetropolitan Ozark counties with 20,000 or more population.

The fourth column of Table 3 shows results from a study by Klindt and Smith [2]. In that study multipliers were estimated by input-output analysis techniques from primary data during 1974

Table 3. Estimated county employment multipliers from four studies

	Current <sup>a</sup> study	Braschler and Kuehn <sup>b</sup> "1"	Braschler and Kuehn <sup>c</sup> "2"	Klindt and Smith <sup>d</sup>	Pepper and Clonts <sup>e</sup>
Agriculture	2.17	2.43	3.06	1.23	2.34
Manufacturing	1.89	2.08	2.10	1.15	1.56
Construction	3.89	2.69	2.84	X	1.40
FIRE	1.36	X	X	1.79	1.49
Transportation and communication	4.72	3.21	4.54	X	1.69
Mining	3.46	2.47	2.94	X	X
				1.94	
Services	2.77	3.49	3.79	1.19	
Eating, drinking and lodging	X	X	X	1.08	X
Wholesale and retail trade	1.54	3.51	3.95	1.46	1.71
Automotive	X	X	X	1.34	X
Professions	X	3.04	2.98	X	X
Military	X	3.84	1.29	X	X
Public administration	X	3.62	3.37	1.20	1.64 (local & state) 2.10 (federal)

<sup>a</sup> Results from current study.<sup>b</sup> Results from Braschler and Kuehn [1] for counties with populations of less than 20,000.<sup>c</sup> Results from Braschler and Kuehn [1] for population of 20,000 or more.<sup>d</sup> Results from Klindt and Smith [2].<sup>e</sup> Results from Pepper and Clonts [3].

in Tennessee. Results applied to a composite one-county area comprised of data from three rural counties. The average 1973 population of the counties was 13,449.

The fifth column of Table 3 shows results from a study by Pepper and Clonts [3]. Secondary data were used in a case study of Talladega County, Alabama (1970 population of 62,280).

A direct comparison of multipliers was difficult due to differences in method, composition of industrial groups, size of economy under study and, particularly in the case studies, the economic structure and trading patterns in the areas under study. However, certain general comparisons may be made. The studies which used cross-sectional data and OLS techniques (columns 1, 2 and 3) yielded larger multipliers in general than did the case studies (columns 4 and 5). This difference may stem from an underestimation of base employment in the OLS studies which tended to result in overestimated multipliers. Alternatively, the case studies may have failed to capture all of the intracounty economic interaction in estimated multipliers. A third explanation is that the case studies may have been conducted for counties with atypical economic structures and trading patterns.

In comparison of results from the current study with other results, estimated multipliers for the agriculture, manufacturing, and FIRE industries appeared relatively consistent. Moreover, the estimated multiplier for the wholesale and retail trade industry was consistent with estimates from the two case studies but was lower than estimates from the Braschler and Kuehn study. The estimated multiplier for the services industry was higher than those estimated in the two case studies but lower than comparable estimates from the Braschler and Kuehn study. For the remaining three industries—mining, construction, and transportation and communications—the estimated multipliers were higher than comparable estimates from the other studies.

### LIMITATIONS

A primary limitation of this study is that results are based on a cross-section of nonmetropolitan counties and, therefore, have limited applicability for specific counties. Industrial trading patterns in a given county influence the magnitude of multipliers for that county. These trading patterns, of course, vary among counties. This study was intended to provide estimates of "typical" multipliers for use in generalized planning. The methods used do not require the use of primary data and the concomitant costs asso-

ciated with obtaining the data needed for case studies such as input-output analysis. Case studies provide more information of the effect of interindustry linkages for specific counties and should be used when such information is required.

## CONCLUSIONS

The objective of this study was to estimate base employment multipliers for broad SIC groups in nonmetropolitan Tennessee counties. A base employment multiplier indicates the total amount of employment in an area which would result from the employment of one person in a given industry for export trade. For example, the estimated multiplier for the agricultural industry was 2.17. This implies that if an additional person were employed in the agricultural industry, interindustry trade would be generated within the county so that total employment would be increased by 2.17 jobs, or 1.17 jobs in addition to the original agricultural employee. The 1.17 jobs would occur in industries throughout the county. Estimated base employment multipliers for other industries were: manufacturing, 1.89; mining, 3.46; construction, 3.89; transportation and communication, 4.72; wholesale and retail trade, 1.54; finance, insurance and real estate, 1.36; services, 2.77.

This study was undertaken in an effort to provide information on county level employment multipliers but circumvent the costly procedures of input-output analysis. The results are intended for use by public planners when general information on the economic impact of action at the county level is desired. The results are neither suited nor intended for application to specific counties.

In general, results of the estimating procedures yielded results which were consistent with expectations and model results were statistically significant. Moreover, the results of this study appeared to be consistent with other similar studies. This lends credence to the conclusion that OLS techniques can be used to measure the effects of interaction among industries in nonmetropolitan counties.

Derivation of base multipliers depended upon estimation of export employment for each industry. This estimation was made difficult because of the possibility of simultaneous importation and exportation of an industry's output. Efforts were made in this study to account for both imports and exports; however, refinements in estimation techniques in future research would be valuable.



Appendix Table 1. Estimated coefficients from equation 2 for each mixed industry, in nonmetropolitan Tennessee counties, 1970.

Industry/model statistics	$E_{1j} =$	$b_0$	+	$b_1P_i$	+	$b_2P_i^2$	+	$b_3Y_i$	+	$b_4L_i$	+	$b_5S_i$	+	$b_6R_i$
Construction ( $r^2 = .87$ , $F = 69^{**}$ )	$E_{11} =$	-30	+	.02313 <sup>**</sup> $P_i$	+	.00000006 $P_i^2$	+	.03242 $Y_i$	-	.00057 $L_i$	-	.00027 $S_i$	+	40 $R_i$
Transportation and utilities ( $r^2 = .78$ , $F = 38^{**}$ )	$E_{12} =$	-212 <sup>*</sup>	+	.01464 <sup>**</sup> $P_i$	+	.00000001 $P_i^2$	+	.11634 <sup>**</sup> $Y_i$	-	.00180 $L_i$	+	.00039 $S_i$	+	19 $R_i$
Wholesale and retail trade ( $r^2 = .95$ , $F = 211^{**}$ )	$E_{13} =$	-621 <sup>**</sup>	+	.07075 <sup>**</sup> $P_i$	-	.00000001 $P_i^2$	+	.19741 <sup>**</sup> $Y_i$	-	.01187 <sup>**</sup> $L_i$	-	.00063 $S_i$	+	96 <sup>*</sup> $R_i$
Finance, insurance and real estate ( $r^2 = .90$ , $F = 99^{**}$ )	$E_{14} =$	-109 <sup>**</sup>	+	.00569 <sup>**</sup> $P_i$	+	.00000010 <sup>*</sup> $P_i^2$	+	.05001 <sup>**</sup> $Y_i$	-	.00154 <sup>*</sup> $L_i$	+	.00005 $S_i$	+	17 $R_i$
Services ( $r^2 = .87$ , $F = 75^{**}$ )	$E_{15} =$	-504	+	.08466 <sup>**</sup> $P_i$	+	.00000002 $P_i^2$	+	.13763 $Y_i$	-	.00995 $L_i$	+	.00059 $S_i$	+	48 $R_i$

\*Indicates significance at the .05 level.

\*\*Indicates significance at the .01 level.

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J. I. Sewell, Assistant Dean  
O. Clinton Shelby, Director of Business Affairs  
G. W. F. Cavender, Director, Office of Communications

Department Heads

C. J. Southards, Agricultural Biology	Food Science, Nutrition,
J. A. Martin, Agricultural Economics	and Food Systems Administration
and Rural Sociology	J. T. Miles, Food Technology and
D. H. Luttrell, Agricultural	Science
Engineering	J. W. Barrett, Forestry
R. R. Johnson, Animal Science	D. B. Williams, Ornamental Horticul-
Judith L. Kuipers, Child and	ture and Landscape Design
Family Studies	L. F. Seatz, Plant and Soil Science
	Anna J. Treece, Textiles and Clothing

Agricultural  
Research Units

Main Station, Knoxville, John Hodges III, Superintendent of Farms  
University of Tennessee Comparative Animal Research Laboratory, Oak  
Ridge, H. E. Walburg, Laboratory Director  
The University of Tennessee at Martin, Martin, Harold J. Smith, Dean, School  
of Agriculture.

Branch Stations

Dairy Experiment Station, Lewisburg, J. R. Owen, Superintendent  
Highland Rim Experiment Station, Springfield, L. M. Safley, Superintendent  
Middle Tennessee Experiment Station, Spring Hill, J. W. High, Jr., Super-  
intendent  
Plateau Experiment Station, Crossville, R. D. Freeland, Superintendent  
Tobacco Experiment Station, Greeneville, Donald D. Howard, Superintendent  
West Tennessee Experiment Station, Jackson, H. W. Luck, Superintendent

Field Stations

Ames Plantation, Grand Junction, James M. Bryan, Superintendent  
Forestry Field Stations at Tullahoma, Wartburg, and Oak Ridge, Richard M.  
Evans, Superintendent  
Milan Field Station, Milan, T. C. McCutchen, Superintendent